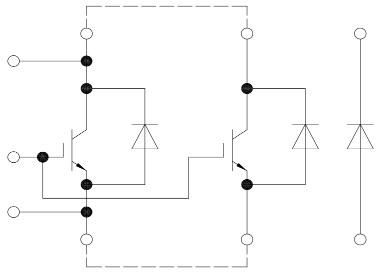
技术信息 / Technical Information

IGBT-模块
IGBT-Module

FD1600/1200R17HP4_B2

IHM-B 模块 采用斩波拓扑
IHM-B module with chopper configuration

Typical Appearance



V_{CES} = 1700V
$I_{C\ nom}$ = 1600A / I_{CRM} = 3200A

典型应用
- 斩波应用
- 大功率变流器
- 牵引变流器
- 风力发电机

Typical Applications
- Chopper applications
- High power converters
- Traction drives
- Wind turbines

电气特性
- 提高工作结温 $T_{vj\ op}$
- 低 V_{CEsat}

Electrical Features
- Extended operating temperature $T_{vj\ op}$
- Low V_{CEsat}

机械特性
- 4 kV 交流 1分钟 绝缘
- 碳化硅铝（AlSiC）基板提供更高的温度循环能力
- 封装的 CTI > 400
- 高爬电距离和电气间隙
- 高功率循环和温度循环能力
- 高功率密度
- IHM B 封装

Mechanical Features
- 4 kV AC 1min insulation
- AlSiC base plate for increased thermal cycling capability
- Package with CTI > 400
- High creepage and clearance distances
- High power and thermal cycling capability
- High power density
- IHM B housing

Module Label Code

Barcode Code 128

00000123456000000000000

DMX - Code

Content of the Code	Digit
Module Serial Number	1 - 5
Module Material Number	6 - 11
Production Order Number	12 - 19
Datecode (Production Year)	20 - 21
Datecode (Production Week)	22 - 23

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IGBT, 斩波器 / IGBT-Chopper

最大额定值 / Maximum Rated Values

集电极 - 发射极电压 Collector-emitter voltage	T_{vj} = -40°C T_{vj} = 25°C T_{vj} = 150°C	V_{CES}	1570 1700 1700	V
连续集电极直流电流 Continuous DC collector current	T_C = 100°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	1600	A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	3200	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	10,5	kW
栅极 - 发射极峰值电压 Gate-emitter peak voltage		V_{GES}	+/-20	V

特征值 / Characteristic Values

				min.	typ.	max.	
集电极 - 发射极饱和电压 Collector-emitter saturation voltage	I_C = 1600 A, V_{GE} = 15 V I_C = 1600 A, V_{GE} = 15 V I_C = 1600 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		1,90 2,30 2,40	2,25	V V V
栅极阈值电压 Gate threshold voltage	I_C = 64,0 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,20	5,80	6,40	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V		Q_G		17,0		µC
内部栅极电阻 Internal gate resistor	T_{vj} = 25°C		R_{Gint}		0,97		Ω
输入电容 Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		130		nF
反向传输电容 Reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{res}		4,20		nF
集电极-发射极截止电流 Collector-emitter cut-off current	V_{CE} = 1570 V, V_{GE} = 0 V, T_{vj} = 25°C		I_{CES}			5,0	mA
栅极-发射极漏电流 Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25°C		I_{GES}			400	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	I_C = 1600 A, V_{CE} = 900 V V_{GE} = ±15 V R_{Gon} = 1,1 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0,40 0,43 0,45		µs µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 1600 A, V_{CE} = 900 V V_{GE} = ±15 V R_{Gon} = 1,1 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,18 0,20 0,20		µs µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 1600 A, V_{CE} = 900 V V_{GE} = ±15 V R_{Goff} = 0,6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		1,05 1,20 1,20		µs µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 1600 A, V_{CE} = 900 V V_{GE} = ±15 V R_{Goff} = 0,6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,30 0,46 0,51		µs µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 1600 A, V_{CE} = 900 V, L_S = 50 nH V_{GE} = ±15 V R_{Gon} = 1,1 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		380 500 535		mJ mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 1600 A, V_{CE} = 900 V, L_S = 50 nH V_{GE} = ±15 V R_{Goff} = 0,6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		420 570 600		mJ mJ mJ
短路数据 SC data	V_{GE} ≤ 15 V, V_{CC} = 1000 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 10 µs, T_{vj} = 150°C	I_{SC}		7500		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			11,6	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		15,0		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

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二极管，制动-斩波器 / Diode, Brake-Chopper

最大额定值 / Maximum Rated Values

反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = -40°C T_{vj} = 25°C T_{vj} = 150°C	V_{RRM}	1570 1700 1700	V
连续正向直流电流 Continuous DC forward current		I_F	1600	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	3200	A
I2t-值 I^2t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I^2t	630 595	kA^2s kA^2s
最大损耗功率 Maximum power dissipation	T_{vj} = 125°C	P_{RQM}	2400	kW
最小开通时间 Minimum turn-on time		$t_{on\ min}$	10,0	µs

特征值 / Characteristic Values

				min.	typ.	max.	
正向电压 Forward voltage	I_F = 1600 A, V_{GE} = 0 V I_F = 1600 A, V_{GE} = 0 V I_F = 1600 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		1,65 1,65 1,65	2,10	V V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 1600 A, - di_F/dt = 9000 A/µs (T_{vj}=150°C) V_R = 900 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		1700 1950 2000		A A A
恢复电荷 Recovered charge	I_F = 1600 A, - di_F/dt = 9000 A/µs (T_{vj}=150°C) V_R = 900 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		450 740 840		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 1600 A, - di_F/dt = 9000 A/µs (T_{vj}=150°C) V_R = 900 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		250 460 525		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			15,9	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		16,0		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\ op}$	-40		150	°C

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反向二极管 / Diode, Reverse

最大额定值 / Maximum Rated Values

反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = -40°C T_{vj} = 25°C T_{vj} = 150°C	V_{RRM}	1570 1700 1700	V
连续正向直流电流 Continuous DC forward current		I_F	1200	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	2400	A
I2t-值 I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I^2t	140 130	kA²s kA²s
最大损耗功率 Maximum power dissipation	T_{vj} = 125°C	P_{RQM}	1200	kW
最小开通时间 Minimum turn-on time		$t_{on\ min}$	10,0	µs

特征值 / Characteristic Values

				min.	typ.	max.	
正向电压 Forward voltage	I_F = 1200 A, V_{GE} = 0 V I_F = 1200 A, V_{GE} = 0 V I_F = 1200 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		1,80 1,90 1,95	2,20	V V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 1200 A, - di_F/dt = 7700 A/µs (T_{vj}=150°C) V_R = 900 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		1250 1350 1400		A A A
恢复电荷 Recovered charge	I_F = 1200 A, - di_F/dt = 7700 A/µs (T_{vj}=150°C) V_R = 900 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		280 460 510		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 1200 A, - di_F/dt = 7700 A/µs (T_{vj}=150°C) V_R = 900 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		180 300 345		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			31,9	K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		32,5		K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\ op}$	-40		150	°C

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模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		4,0		kV
模块基板材料 Material of module baseplate				AlSiC		
爬电距离 Creepage distance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal			32,2 32,2		mm
电气间隙 Clearance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal			19,1 19,1		mm
相对电痕指数 Comperative tracking index		CTI		> 400		
			min.	typ.	max.	
杂散电感,模块 Stray inductance module		L_{sCE}		6,0		nH
模块引线电阻,端子-芯片 Module lead resistance, terminals - chip	T_C = 25°C, 每个开关 / per switch	$R_{CC'+EE'}$ $R_{AA'+CC'}$		0,15 0,24		mΩ
储存温度 Storage temperature		T_{stg}	-40		150	°C
模块安装的安装扭距 Mounting torque for modul mounting	螺丝 M6 根据相应的应用手册进行安装 Screw M6 - Mounting according to valid application note	M	4,25		5,75	Nm
端子联接扭距 Terminal connection torque	螺丝 M4 根据相应的应用手册进行安装 Screw M4 - Mounting according to valid application note 螺丝 M8 根据相应的应用手册进行安装 Screw M8 - Mounting according to valid application note	M	1,8 8,0	- -	2,1 10	Nm Nm
重量 Weight		G		1200		g

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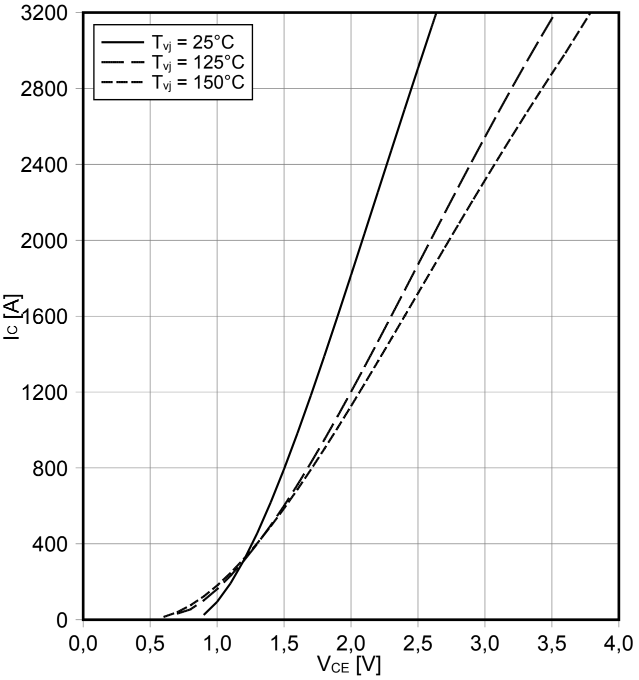
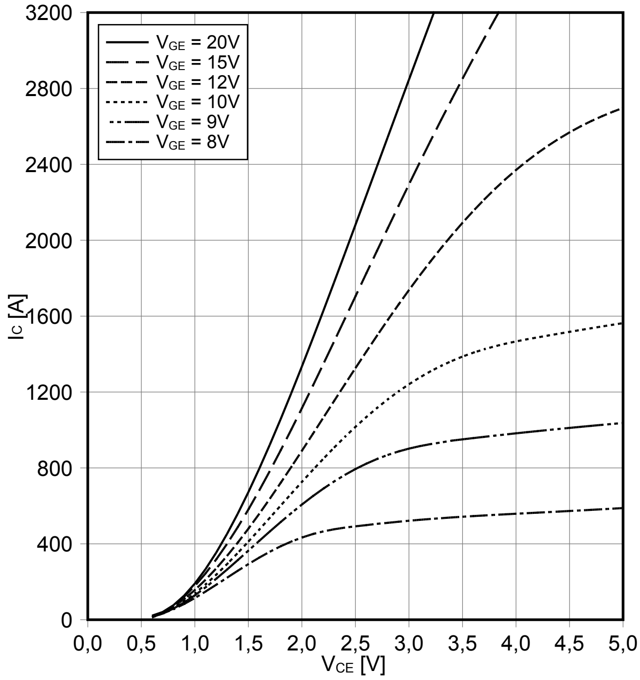
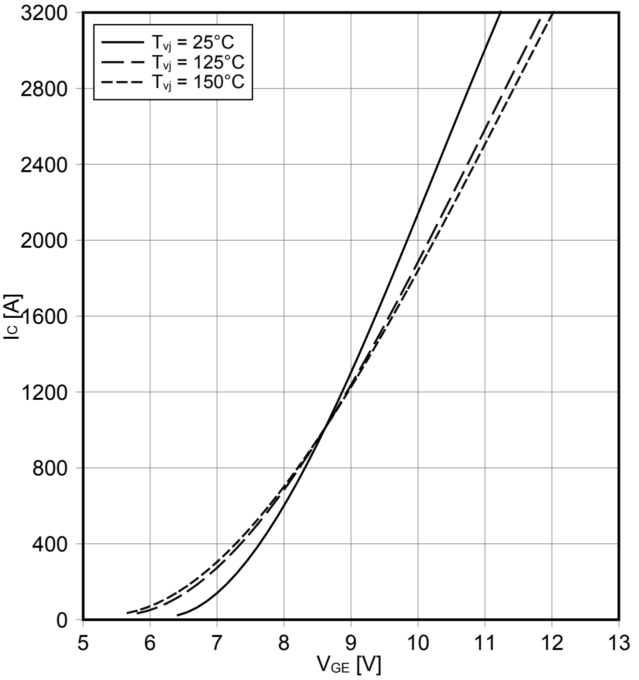
输出特性 IGBT, 斩波器 (典型)
output characteristic IGBT-Chopper (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



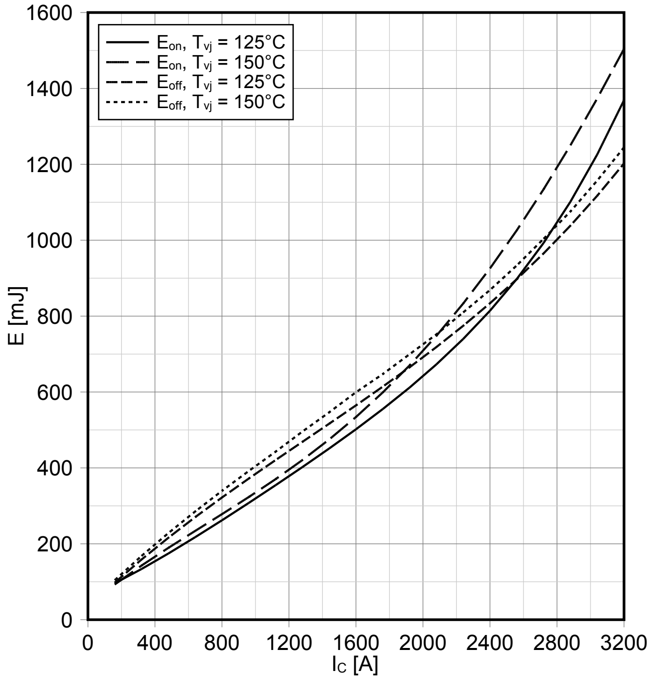
输出特性 IGBT, 斩波器 (典型)
output characteristic IGBT-Chopper (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



传输特性 IGBT, 斩波器 (典型)
transfer characteristic IGBT-Chopper (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



开关损耗 IGBT, 斩波器 (典型)
switching losses IGBT-Chopper (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm 15$ V, $R_{Gon} = 1.1\ \Omega$, $R_{Goff} = 0.6\ \Omega$, $V_{CE} = 900$ V



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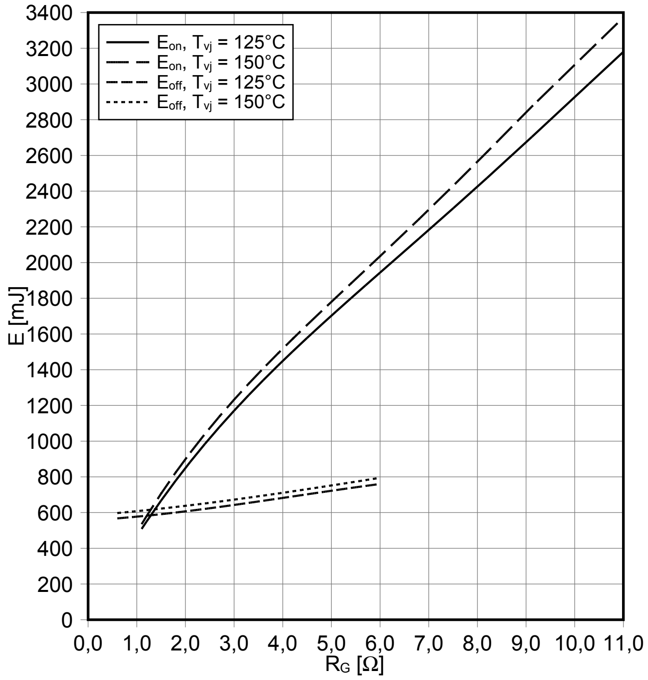
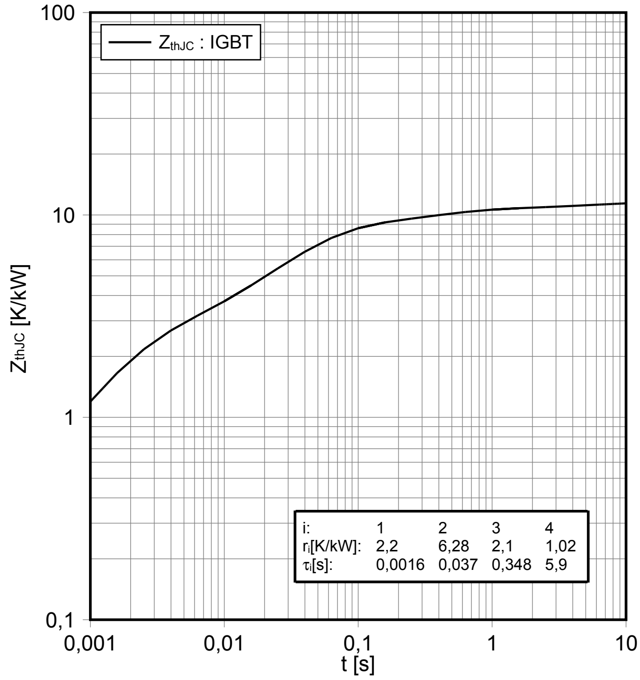
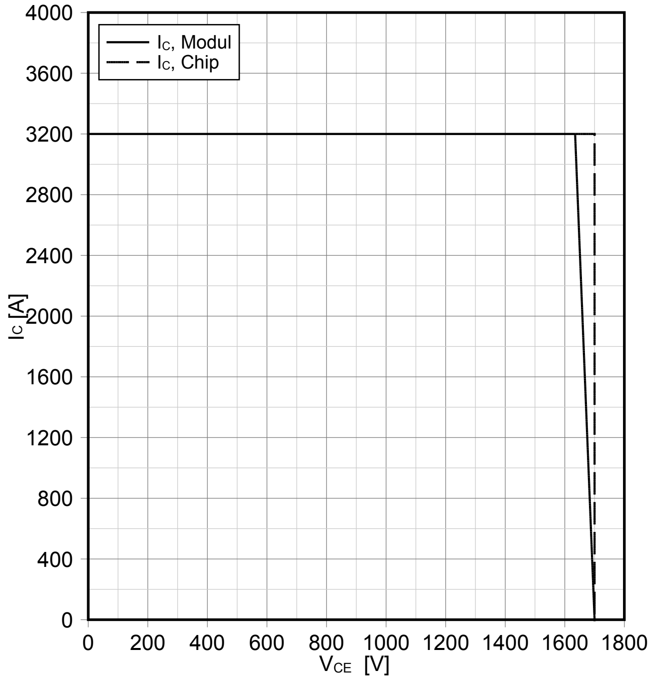
开关损耗 IGBT, 斩波器 （典型)
switching losses IGBT-Chopper (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = ±15 V, I_C = 1600 A, V_{CE} = 900 V



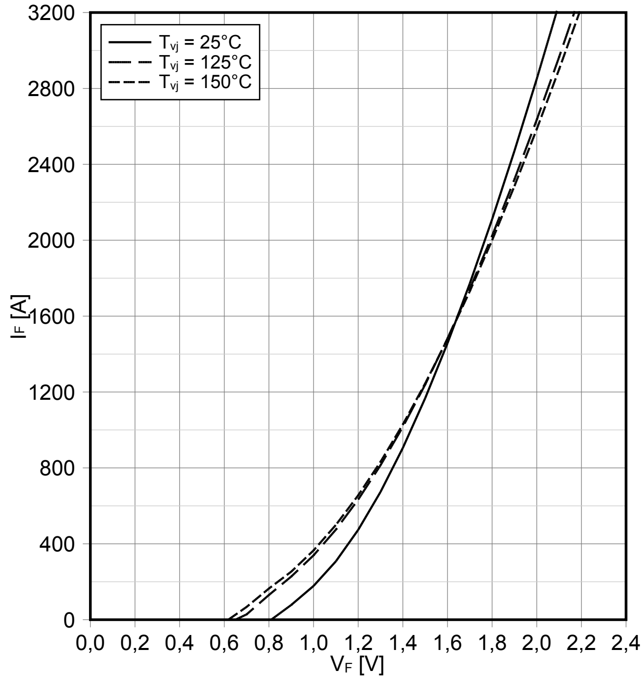
瞬态热阻抗 IGBT, 斩波器
transient thermal impedance IGBT-Chopper
Z_{thJC} = f (t)



反偏安全工作区 IGBT, 斩波器 （RBSOA）
reverse bias safe operating area IGBT-Chopper (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 0.6 Ω, T_{vj} = 150°C



正向偏压特性 二极管，制动-斩波器 （典型)
forward characteristic of Diode, Brake-Chopper (typical)
I_F = f (V_F)



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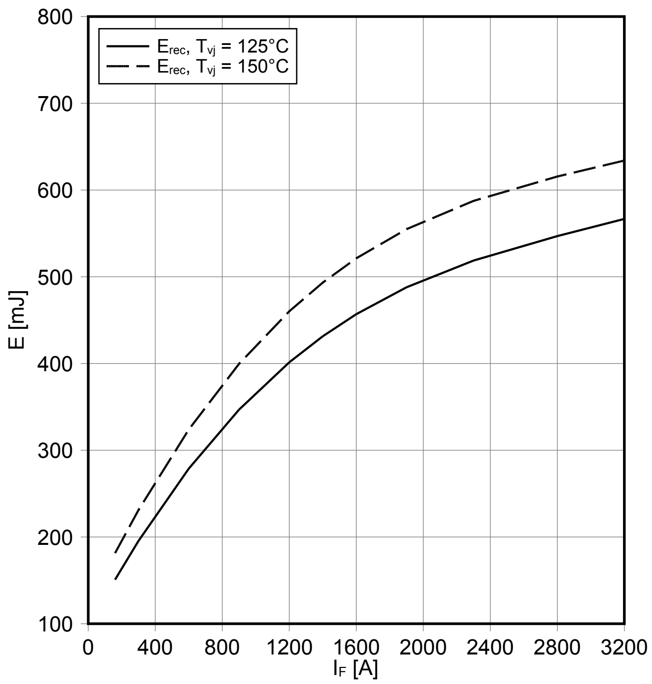
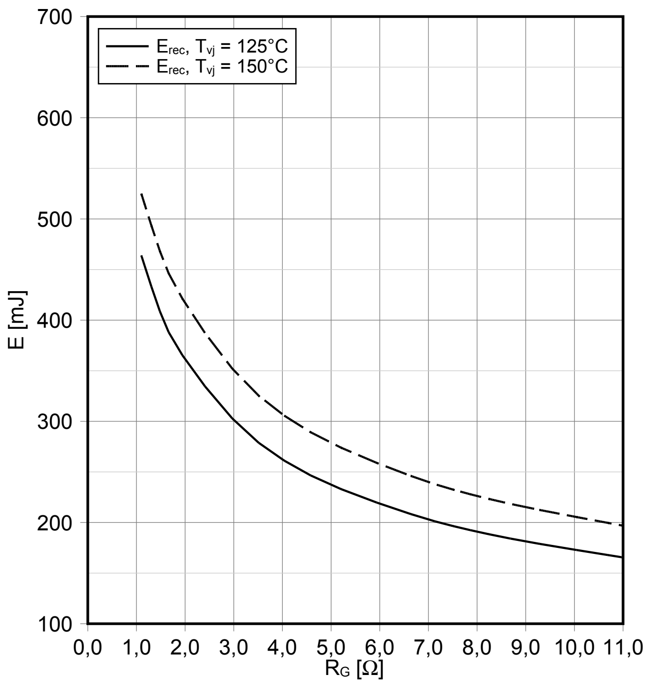
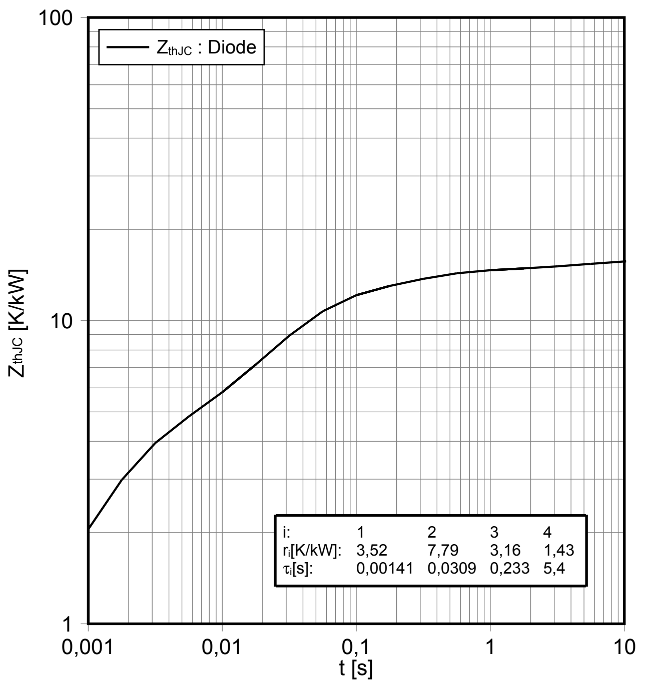
开关损耗 二极管，制动-斩波器 （典型)
switching losses Diode, Brake-Chopper (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 1.1\ \Omega$, $V_{CE} = 900$ V



开关损耗 二极管，制动-斩波器 （典型)
switching losses Diode, Brake-Chopper (typical)
$E_{rec} = f(R_G)$
$I_F = 1600$ A, $V_{CE} = 900$ V

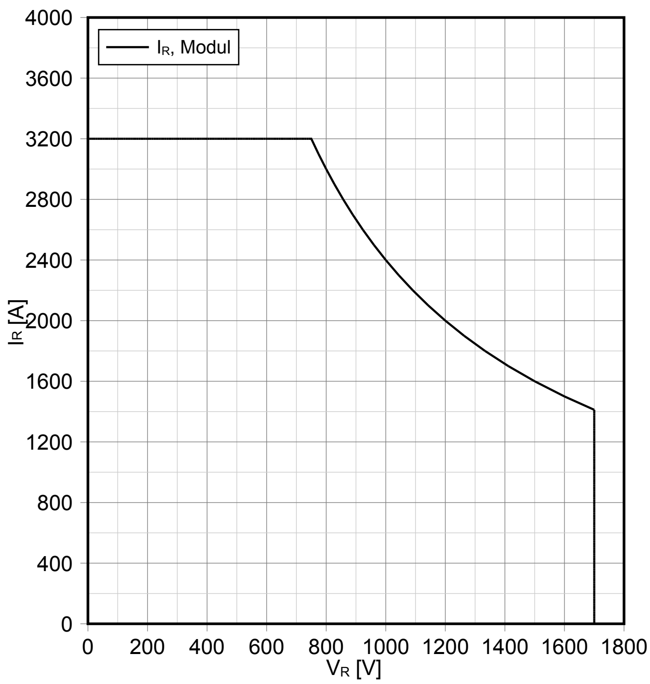


瞬态热阻抗 二极管，制动-斩波器
transient thermal impedance Diode, Brake-Chopper
$Z_{thJC} = f(t)$



i:	1	2	3	4
r_i[K/kW]:	3,52	7,79	3,16	1,43
τ_i[s]:	0,00141	0,0309	0,233	5,4

安全工作区 二极管，制动-斩波器 (SOA)
safe operation area Diode, Brake-Chopper (SOA)
$I_R = f(V_R)$
$T_{vj} = 150$°C



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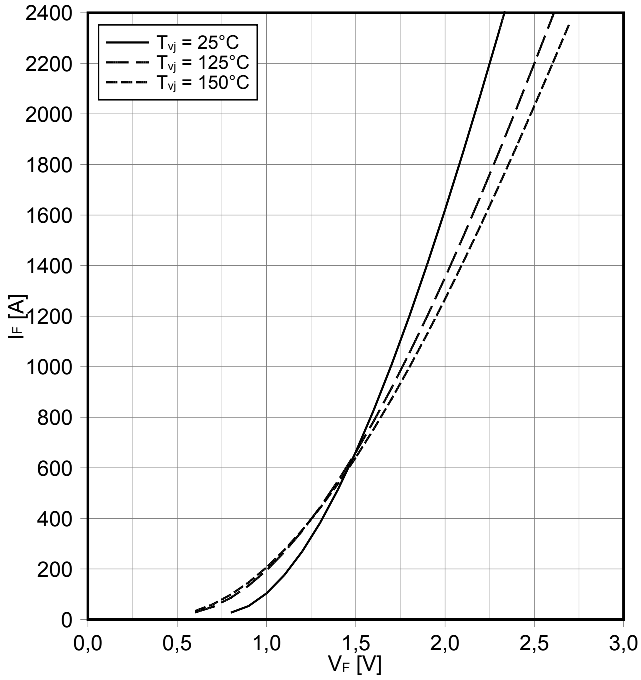
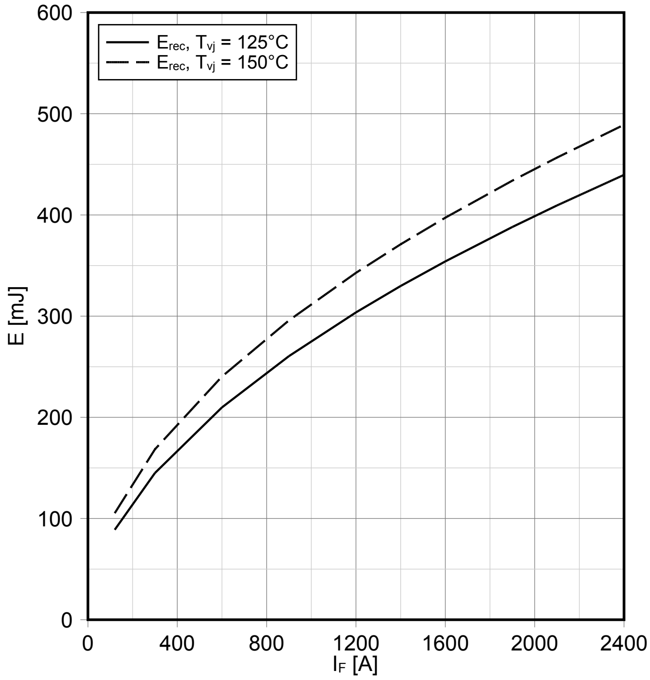
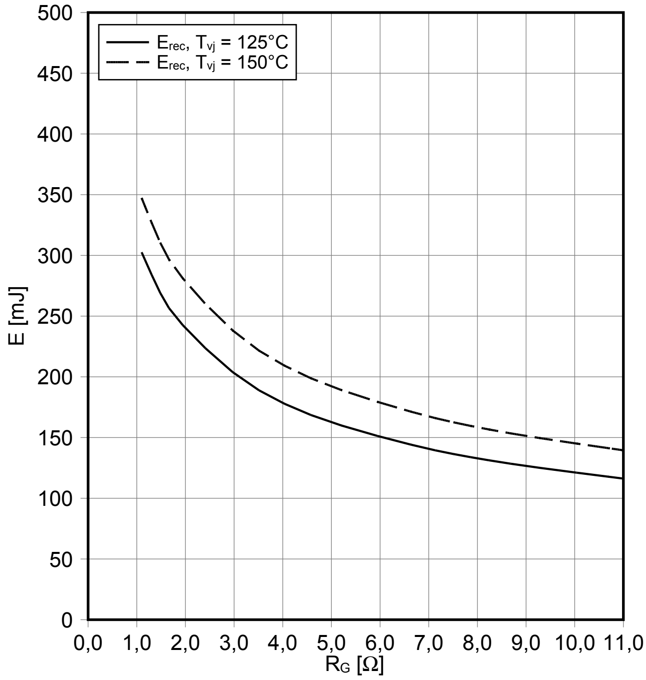
正向偏压特性 反向二极管 （典型）
forward characteristic of Diode, Reverse (typical)
$I_F = f(V_F)$



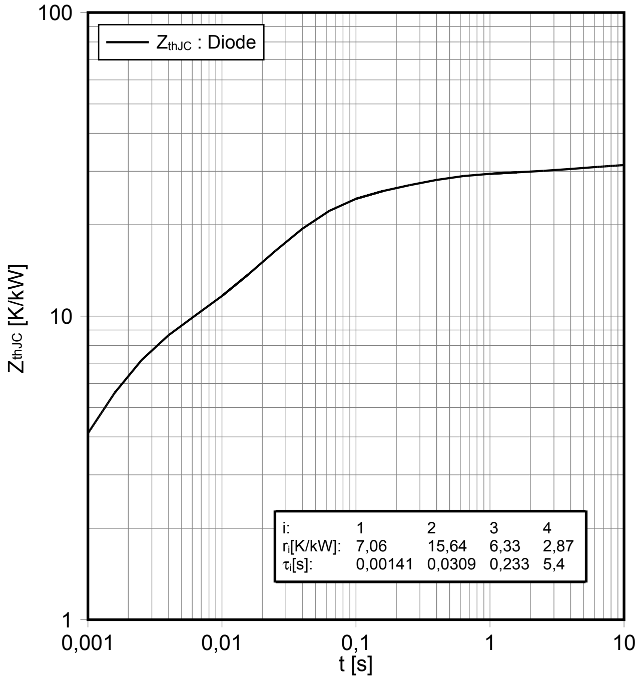
开关损耗 反向二极管 （典型）
switching losses Diode, Reverse (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 1.1\ \Omega$, $V_{CE} = 900$ V



开关损耗 反向二极管 （典型）
switching losses Diode, Reverse (typical)
$E_{rec} = f(R_G)$
$I_F = 1200$ A, $V_{CE} = 900$ V



瞬态热阻抗 反向二极管
transient thermal impedance Diode, Reverse
$Z_{thJC} = f(t)$



i:	1	2	3	4
r_i[K/kW]:	7,06	15,64	6,33	2,87
τ_i[s]:	0,00141	0,0309	0,233	5,4

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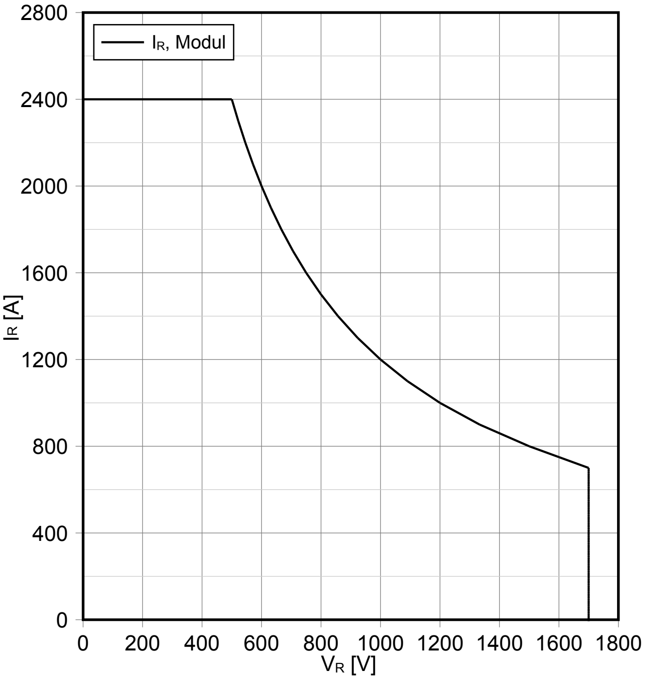
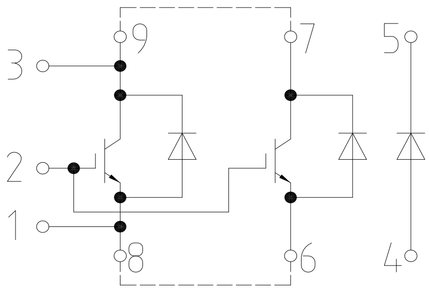
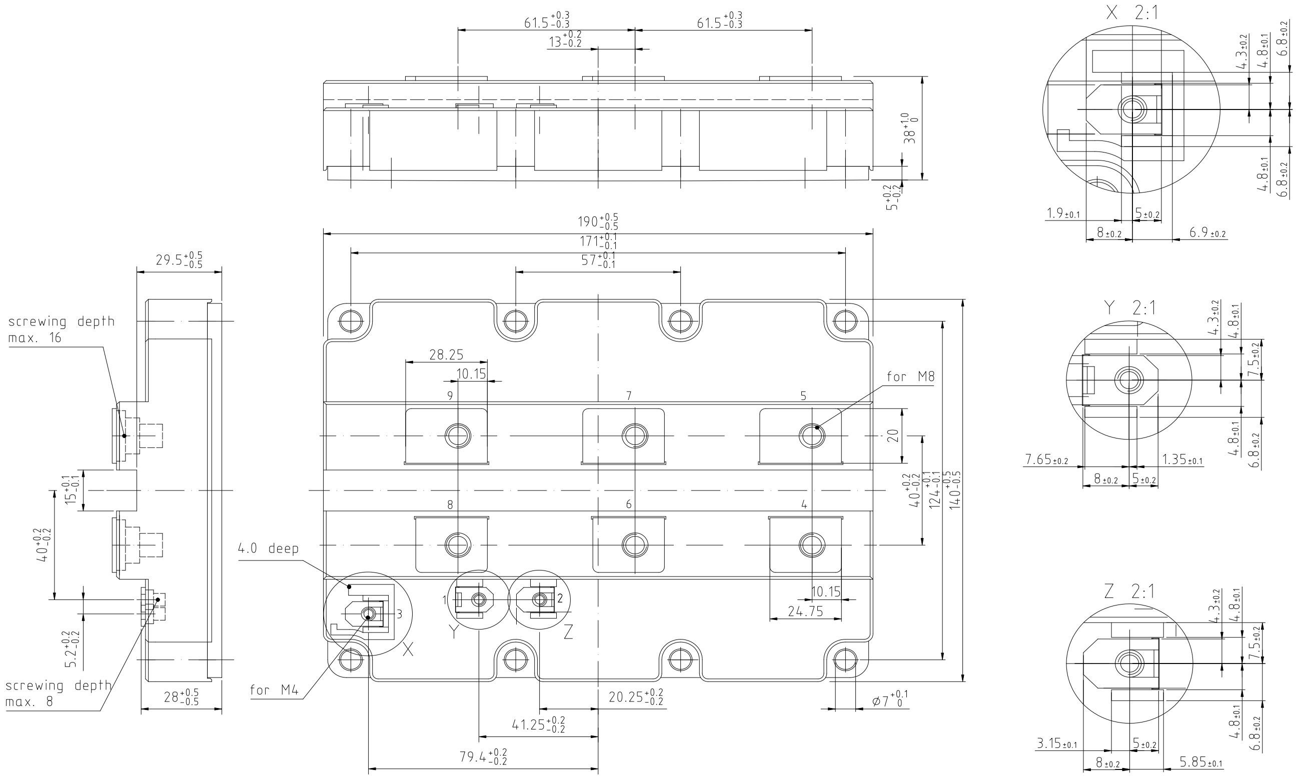
安全工作区 反向二极管 (SOA)
safe operation area Diode, Reverse (SOA)
$I_R = f(V_R)$
$T_{vj} = 150°C$



接线图 / Circuit diagram



封装尺寸 / Package outlines



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